

CLAIMS

1. A three-way solenoid valve, comprising:

- a first pilot valve,
- a second pilot valve,
- an inlet port,
- an outlet port, and
- an exhaust port,

wherein:

said inlet port is connected to said outlet port and said exhaust port is closed when both said first pilot valve and said second pilot valve are de-energized;

said inlet port, said outlet port, and said exhaust port are closed when said first pilot valve is energized and said second pilot valve is de-energized; and

said outlet port is connected to said exhaust port and said inlet port is closed when said first pilot valve is de-energized and said second pilot valve is energized.

2. A three-way solenoid valve according to Claim 1, further characterized by comprising:

- (1) a two-way valve comprising

- (A) said first pilot valve whose operation mode is normally-open or normally-closed

- (B) a first main valve whose operation mode is different from said first pilot valve

- (2) a three-way valve connected serially to said two-way valve comprising

- (A) said second pilot valve whose operation mode is normally-

open or normally-closed

(B) a second main valve whose operation mode is different from said first pilot valve.

3. A three-way solenoid valve according to Claim 2, wherein each of said first pilot valve, said first main valve, said second pilot valve, and said second main valve has a valve body; said valve body of each of said first pilot valve, said first main valve, said second pilot valve, and said second main valve being poppet type or spool type.

4. A three-way solenoid valve according to Claim 3, wherein said first pilot valve, said first main valve, said second pilot valve, and said second main valve are housed in a single housing.

5. An anti-lock brake system for a trailer hauled by a motor-powered car, which comprises brake command output unit, comprising:

(A) a braking force generating unit for generating braking force to a plurality of wheels of said trailer;

(B) an anti-skid valve for relaxing the braking force generated by said braking force generating unit;

(C) a plurality of skid detection units, each one of said plurality of skid detection units detecting skid of the wheels to which said respective one of said plurality of skid detection unit is installed;

(D) an anti-skid brake system controller for outputting to said anti-skid valve on the basis of a signal from said skid detection unit a command instructing relaxation of the braking force;

(E) a secondary battery for providing electric power to said braking force generating unit, said plurality of skid detection unit, and said anti-skid brake system controller; and

(F) a generator for charging said secondary battery;
wherein said generator is installed on at least one of said plurality of wheels and generates power in response to the rotation of said one of said plurality of wheels; and

said secondary battery is charged with power generated by said generator.

6. An anti-lock brake system according to Claim 5, wherein said anti-skid valve comprising:

(1) a two-way valve comprising

(A) a first pilot valve whose operation mode is normally-open or normally-closed

(B) a first main valve whose operation mode is different from said first pilot valve

(2) a three-way valve connected serially to said two-way valve comprising

(A) a second pilot valve whose operation mode is normally-open or normally-closed

(B) a second main valve whose operation mode is different from said first pilot valve.

7. An anti-lock brake system according to Claim 5, wherein:

the power generated by said generator increases with the increase rotational frequency of said wheel; and

said generator generates enough power to charge said secondary battery when the rotational frequency of said wheel exceeds a predetermined value.

8. An anti-lock brake system according to Claim 5, further comprising a power supply control unit for causing said secondary battery to provide power

to said skid detection unit and said anti-skid brake system controller when said anti-lock brake system is in operation.

9. An anti-lock brake system according to Claim 7, further comprising a power supply control unit for causing said secondary battery to provide power to said skid detection unit and said anti-skid brake system controller when said anti-lock brake system is in operation.

10. An anti-lock brake system according to Claim 5, wherein said secondary battery is an electric double layer capacitor.

11. An anti-lock brake system according to Claim 7, wherein said secondary battery is an electric double layer capacitor.

12. An anti-lock brake system according to Claim 8, wherein said secondary battery is an electric double layer capacitor.

13. An anti-lock brake system according to Claim 5, wherein the brake command is transmitted by wired communication.

14. An anti-lock brake system according to Claim 5, wherein the brake command is transmitted by wireless communication.

15. An anti-lock brake system according to Claim 5, further comprising a pipe installed from said power car to said trailer,
wherein the brake command is transmitted through the fluid within said pipe.

16. An anti-lock brake system according to Claim 15, further comprising a

pressure sensor for monitoring the pressure of the fluid and for outputting a brake command.

17. An anti-lock brake system according to Claim 10, wherein said electric double layer capacitor comprises:

- a laminated capacitor cell made by laminating a plurality of capacitor unit cell having two activated carbon powder electrodes and sulfuric acid solution;

- a housing for housing said laminated capacitor cell; and

- at least one mounting portion for mounting said electric double layer capacitor on another device;

- wherein said housing is made of functionally graded aluminum – ceramic material and

- said mounting portion and said housing being formed in one piece.

18. An anti-lock brake system according to Claim 17, wherein:

- said housing has rectangular parallelepiped shape;

- a plurality of mounting portions being installed at the bottom of said housing;

- said plurality of mounting portions and said housing formed in one piece;

- said plurality of mounting portions being installed in a zigzag pattern or randomly;

- said housing is electrically insulated from said electrodes; and

- said electrodes are located at one plane of said housing.

19. An anti-lock brake system according to Claim 17, wherein:

- said plurality of capacitor unit cells being serial-connected to each other through electricity;

the output voltage of said laminated capacitor cell per said housing is in the range of 15 – 60 V DC; and

the capacitance of said laminated capacitor cell per said housing is in the range of 1 – 100 F.

20. An anti-lock brake system according to Claim 17, wherein said electric double layer capacitor further comprises an LED display for displaying output voltage and remaining capacitance of said electric double layer capacitor.

21. An electric double layer capacitor comprising (A) a laminated capacitor cell made by laminating a plurality of capacitor unit cells having two activated carbon powder electrodes and sulfuric acid solution, (B) a housing for housing said laminated capacitor cell, and (C) at least one mounting portion for mounting said electric double layer capacitor on another device, characterized in that:

said housing is made of functionally graded aluminum – ceramic material; and

said mounting portion and said housing being formed in one piece.

22. An electric double layer capacitor according to Claim 21, wherein:

said housing has rectangular parallelepiped shape;

a plurality of mounting portions being installed at the bottom of said housing;

said plurality of mounting portions and said housing are formed in one piece;

said plurality of mounting portions being placed in a zigzag arrangement or dispersedly;

said housing is electrically insulated from said electrodes; and

said electrodes being located on one plane of said housing.

23. An electric double layer capacitor according to Claim 21, wherein:
said plurality of capacitor unit cells being serial-connected to each other through electricity;
the output voltage of said laminated capacitor cell per said housing is in the range of 15 – 60 V DC; and
the capacitance of said laminated capacitor cell per said housing is in the range of 1 – 100 F.
24. An electric double layer capacitor according to Claim 21, further comprising an LED display for displaying output voltage and remaining capacitance of said electric double layer capacitor.
25. An anti-lock brake control method for vehicles comprising (A) an anti-skid valve comprising (1) a two-way valve comprising a first pilot valve whose operation mode is normally-open or normally-closed and a first main valve whose operation mode is different from said first pilot valve and (2) a three-way valve connected serially to said two-way valve comprising a second pilot valve whose operation mode is normally-open or normally-closed and a second main valve whose operation mode is different from said first pilot valve, (B) a plurality of wheels, and (C) an actuator for applying braking force to said plurality of wheels, comprising the steps of:
braking force generating step for generating braking force;
calculation step for calculating a parameter showing whether wheel is skidding;
determination step for determining whether said parameter exceeds a predetermined value;
relaxation step for outputting during a first predetermined duration a signal for causing said first pilot valve to be de-energized and said second pilot

valve to be energized when said parameter is determined to exceed said predetermined value;

maintaining step for outputting during a second predetermined duration a signal for causing said first pilot valve to be energized and said second pilot valve to be de-energized after said relaxation step is finished;

re-applying step for outputting a signal for causing both said first pilot valve and said second pilot valve to be de-energized after said relaxation step is finished when said parameter is determined not to exceed said predetermined value in said determination step.